ASSEMBLING DEVICE FOR ASSEMBLING AND DISASSEMBLING A FUEL INJECTOR

~~Background Information~~

The present invention relates to an assembling device for assembling and disassembling a fuel injector, ~~in particular~~ for example a high-pressure direct injector, into and from a mounting hole in a cylinder head of an internal combustion engine. Fuel is injected directly into the combustion chamber of the internal combustion engine through this high-pressure direct injector.

~~The present invention is based on an assembling device according to the definition of the species of the main claim.~~ An assembling device having a jacket body at least partially surrounding the fuel injector is described in ~~already known from~~ German Patent Application ~~197 05 990 A1~~, a collar section directed inward ~~being~~ formed at a first end of the jacket body, and a collar section directed outward ~~being~~ formed at a second end of the jacket body, opposite the first end. While the collar section directed radially inward can be inserted into a groove of the fuel injection valve, the collar section directed outward protrudes outward from the mounting hole of the fuel injection valve. An appropriate tool, for example, an assembling iron, can engage in the collar section protruding from the mounting hole of the cylinder head in order to lift the assembling device together with the fuel injection valve from the mounting hole. In some cases considerable disassembling forces are required because the fuel injection valves ~~because~~ of the fuel injectors may seize in their mounting holes. Therefore the cylinder head, which may be made of light metal, for example, may be damaged by the mounting iron or other lifting tools, ~~which is disadvantageous~~ disadvantageously. Furthermore, it is a disadvantage in the case of the ~~known~~ conventional assembling device that the mounting device transmits no hold-down force to the

fuel injector during the operation of the internal combustion engine, but the fuel injector and the assembling device are held in the mounting hole by friction forces ~~alone, which is disadvantageous~~.

U.S. Patent 4,561,159 describes a disassembling device for a diesel injector. An end area of the fuel injector opposite the spray orifice can be inserted at the side into a slit in the disassembling device. The disassembling device is not inserted into the mounting bore of the cylinder head and it does not remain in the mounting bore when assembled. The disassembling device ~~known from~~ described in U.S. Patent 4,561,159 is instead a tool extension which is attached to the fuel injector before disassembling the fuel injector. No hold-down force is transmitted to the fuel injector. Connecting the disassembling device to the fuel injector ~~here~~ is a relatively complicated process.

The assembling device according to the present invention ~~having the characterizing features of Claim 1 has the~~ has the advantage over the ~~related art~~ that the at least one disassembling screw engaging in a thread of the collar section allows simple and damage-free disassembling of the fuel injector inserted into the assembling device. Disassembling takes place so that the assembling device with the fuel injector is continuously extracted from the mounting hole by tightening the at least one disassembling screw or ~~preferably~~ advantageously the plurality of disassembling screws.

~~Advantageous refinements of and improvements on the assembling device characterized in the main claim are possible through the measures characterized in the subordinate claims.~~

The threads, each assigned to a disassembling screw, peripherally distributed on the collar section, ~~in particular~~ for example two threads for two disassembling screws, can ensure that the disassembling force resulting from the tightening of the

plurality of disassembling screws is directed axially, so that increased friction lock due to a radial force component is avoided. A symmetric, continuous pulling force is achieved through the simultaneous tightening of the disassembling screws. As an alternative, disassembling can also be performed by tightening the plurality of disassembling screws alternately.

It is particularly advantageous that openings, ~~preferably~~ in the form of bore holes, are provided on the collar section, through which assembling screws engage a thread of the cylinder head. By tightening these assembling screws, sufficient hold-down force is transmitted to the assembling device and thus to the fuel injector to hold down the fuel ~~injector during the operation of the internal combustion engine against the combustion pressure prevailing in the~~ combustion chamber. The threads and the openings in the collar section are ~~preferably dimensioned~~ so that the assembling screws can used as disassembling screws at the same time. For this purpose, the threads in the cylinder head and the collar section of the assembling device must have the same diameter and the same taper, and the openings must be dimensioned so that the corresponding screw diameters pass through them. When the fuel injector is disassembled, the mounting screws are loosened first and then the mounting screws used as disassembling screws are introduced in the thread of the collar section and tightened, whereby the assembling device with the fuel injector is extracted of the mounting hole in the cylinder head. No special disassembling screws need to be provided.

~~Preferably~~ at least three openings spaced at an angular distance of 90°, are provided for the mounting screws. This ensures that the hold-down force on the assembling device and thus on the fuel injector is applied uniformly over the periphery.

According to a ~~particularly~~ advantageous embodiment, the contact section of the assembling device engaging the fuel injector has an extension directed radially inward and an axial extension extending axially beyond the radial extension. The axial extension is used for transmitting the hold-down force to the fuel injector, while the radial extension engages a groove of the fuel injector to transmit the disassembling force to the fuel injector. The functions of hold-down and disassembling are separated on the contact section of the assembling device engaging the fuel injector. This has the advantage that the area of the disassembling groove of the fuel injector can be implemented by an injected plastic piece, and the area of the fuel injector engaged by the axial extension must be made of metal. This results in simple and cost-effective manufacturing of the fuel injector housing.

The assembling device can be economically manufactured by deep drawing from sheet metal.

Drawing

Embodiments of the present invention are illustrated in a simplified form in the drawing and are explained in greater detail in the following description.

Figure 1 shows a section through a cylinder head of an internal combustion engine and an embodiment of the assembling device according to the present invention, as well as a fuel injector inserted into the assembling device;

Figure 2 shows an embodiment slightly modified with respect to that of Figure 1 in top view, and

Figure 3 shows a section along line III-III of Figure 2.

Detailed Description of the Embodiments

Figure 1 shows a section through a cylinder head 2 of an internal combustion engine, ~~and through~~ an embodiment of assembling device 1 according to the present invention, ~~as well as~~ and a fuel injector 3 shown unsectioned, inserted into assembling device 1 according to the present invention.

Fuel injector 3 is used for direct injection of fuel into a combustion chamber 4 of the internal combustion engine. Cylinder head 2 has a mounting hole 5 to accommodate fuel injector 3, which in the embodiment illustrated is divided into a narrow section 6 to accommodate an injection section 7 of fuel injector 3, a widened section 8 to accommodate a disassembling section 9, a fuel feed section 10 and a housing body 27 ~~as well as~~ leading into a conical section 11 connecting widened section 8 to narrow section 6.

Assembling device 1 according to the present invention has a jacket body 12, which at least partially surrounds fuel injector 3; a collar section 13 directed outward from mounting hole 5 and extending radially outward from jacket body 12, is formed on jacket body 12. A contact section 14 is formed at the end opposite collar section 13 of jacket body 12, through which assembling device 1 engages with fuel injector 3.

Contact section 14 has an extension 15 directed radially inward and an axial extension 16 extending axially beyond radial extension 15. Radial extension 15 engages in a disassembling groove 17 of fuel injector 3, in order to transmit a disassembling force to fuel injector 3. Axial extension 16 engages in a hold-down surface 18 of fuel injector 3 in order to transmit a hold-down force to fuel injector 3.

At least one, however, ~~preferably~~ advantageously a plurality of unthreaded openings 19 and at least one, however, ~~preferably~~ advantageously a plurality of threaded opening 20 are provided with threads 20 on collar section 13 of assembling device 1. Openings 19 are designed in

this embodiment as unthreaded boreholes, traversed by assembling screws 21, which can be screwed into threaded boreholes 22 of cylinder head 2. Openings 19 may be also designed as elongated holes, slots, recesses opening outward, or the like, for example.

Threads 20 are ~~preferably~~ formed, for example, in threaded holes, with thread 20 being cut directly into collar section 13. It is, however, also ~~conceivable~~ possible to attach threaded bushings or nuts to collar section 13 of assembling device 1.

When fuel injector 3 is assembled, fuel injector 3 is initially inserted into assembling device 1 so that radial extension 15 engages in disassembling groove 17 of fuel injector 3. Then assembling device 1, together with fuel injector 3, is inserted into mounting hole 5 of cylinder head 2. Finally, assembling screws 21 are inserted through openings 19 in collar section 13 and screwed into threads 22 of cylinder head 2. Screw heads 23 of assembling screws 21 contact collar section 13 when assembling screws 21 are tightened and exert a hold-down force F_N indicated by arrow 24 on assembling device 1, which is transmitted via axial extension 16 to hold-down surface 18 of fuel injector 3. Thus, fuel injector 3 is held down in mounting hole 5 against the combustion pressure in combustion chamber 5 during the operation of the internal combustion engine.

In order to disassemble fuel injector 3 and assembling device 1, assembling screws 21 are initially loosened and removed from thread 22 of cylinder head 2. Then disassembling screws 25 are inserted into thread 22 of collar section 13, abutting on cylinder head 2. A disassembling force F_D, indicated by arrow 26, is then exerted on assembling device 1; this force is transmitted to disassembling groove 17 of fuel injector 3 via radial extension 15. Thus assembling device 1, together with fuel injector 3 is extracted from mounting hole 5 of cylinder head 2 without need for an assembling iron or another

lifting tool. Relatively large disassembling forces F_D can be exerted on assembling device 1 and fuel injector 3 via disassembling screws 25, so that fuel injector 3 can be reliably removed to be serviced or replaced even if fuel injector 3 has become seized in mounting hole 5.

Due to the fact that both a radial extension 15 and an axial extension 16 are formed on contact section 14 of assembling device 1, the hold-down and disassembling functions are separated from one another. While housing body 27 of fuel injector 3 on which hold-down surface 18 is formed is ~~preferably made of metal, in particular of~~ steel, in order to enable it to transmit a high hold-down force to fuel injector 3, disassembling section 9 of fuel injector, on which disassembling groove 17 is formed, can be manufactured as an injected plastic piece, since disassembling force F_D is considerably less than hold-down force F_N. This allows fuel injector 3 to be manufactured inexpensively.

Figure 2 shows the top view of an embodiment slightly modified ~~compared~~ to that shown in Figure 1 of an assembling device 1 according to the present invention. Radial extension 15, collar section 13, thread 20 formed on collar section 13, and openings 19 designed as unthreaded bore holes on collar section 13 can be seen. The modification with respect to the embodiment illustrated in Figure 1 is that two threads formed in the threaded bore holes on collar section 13 are diametrically opposite in section plane III-III, while in the embodiment illustrated in Figure 1, one thread 20 and one unthreaded opening 19 are arranged in section plane III-III to better illustrate the present invention.

While both threads 20 on collar section 13 are arranged diametrically opposite one another, three unthreaded openings 19 on collar section 13 are peripherically distributed almost uniformly so that the angular spacing between the individual openings is at least 90°, ~~ideally~~ 120°. Thus a peripherally

uniform hold-down force can be transmitted to fuel injector 3 via assembling device 1 according to the present invention.

As can also be seen from Figure 2, in the embodiment illustrated in Figure 2, radial extension 15 surrounds fuel injector 3 not illustrated in Figure 2 in a smaller angular area than jacket body 12 and/or collar section 13 formed on jacket body 12. This facilitates insertion of fuel injector 3 into assembling device 1.

Figure 3 shows a section along line III-III in Figure 2. The illustration largely corresponds to the illustration of assembling device 1 of Figure 1 with the difference that, as explained previously, two threads 20 are arranged instead of one thread 20 and one unthreaded opening 19.

Assembling device 1 according to the present invention can be manufactured economically as a deep-drawn sheet metal part. Threads 22 on cylinder head 2 and threads 20 on collar 13 of assembling device 1 have the same diameter and the same taper, so that assembling screws 21 can be used as disassembling screws 25 at the same time. Therefore, in order to disassemble assembling device 1 and fuel injector 3, assembling screws 21 are first loosened and removed and then inserted into threads 20 and tightened.

Using assembling device 1 according to the present invention, high symmetric disassembling forces directed axially can be transmitted to fuel injector 3, preventing damage to cylinder head 2 made of light metal, for example.

The present invention is not restricted to the embodiments presented. For example, radial extension 15 may also be implemented via notches on jacket body 12 that are bent so that they protrude radially inward.